

REMARKS/ARGUMENTS

Favorable reconsideration of this application is respectfully requested.

The outstanding Office Action sets forth rejections to claim 1 in the Office Action. However, applicants note that claim 1 is not currently pending in this application.

More specifically, in the present application a Second Preliminary Amendment was filed on November 16, 2004 that canceled claim 1 and that presented new claims 35-79 for examination. Thus, claim 1 is no longer pending in this application and new claims 35-79 are pending.

Applicant's undersigned representative contacted Examiner Garber on May 27, 2005 to point out the filing of the Second Preliminary Amendment, and Examiner Garber requested that a response be filed resubmitting the filed Second Preliminary Amendment.

A copy of that filed Second Preliminary Amendment and the date-stamped filing receipt indicating its filing is provided herewith.

Applicants respectfully request that a new non-final Action be issued on the merits to pending claims 35-79.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
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Due Date None

OSMM&N File No. 259687US2PCT

By MJS/tep/FF

Serial No. 10/509,630

In the matter of the Application of Akira UMEDA

For FREQUENCY CHARACTERISTICS MEASURING METHOD AND DEVICE  
FOR ACCELERATION SENSOR

The following has been received in the U.S. Patent Office on the date stamped hereon:

- Second Preliminary Amendment (with cover sheet)
- Dep. Acct. Order Form
- Credit Card Payment Form for \$2,898.00

DATE RECEIVED

~~Rec'd PCT~~ APTO 16 NOV 2004

Linked to OPTMS	
<u>11-17-04</u>	
DATE	CASE ID

Docket No. 259687US2PCT

IN RE APPLICATION OF: Akira UMEDA

SERIAL NO: 10/509,630

FILED: September 29, 2004

FOR: FREQUENCY CHARACTERISTICS MEASURING METHOD AND DEVICE FOR ACCELERATION SENSOR

COMMISSIONER FOR PATENTS  
ALEXANDRIA, VIRGINIA 22313

SIR:

Transmitted herewith is a second amendment in the above-identified application.

- ☐ No additional fee is required
- ☐ Small entity status of this application under 37 C.F.R. §1.9 and §1.27 is claimed.
- ☐ Additional documents filed herewith:

The Fee has been calculated as shown below:

CLAIMS	CLAIMS REMAINING		HIGHEST NUMBER PREVIOUSLY PAID	NO. EXTRA CLAIMS	RATE	CALCULATIONS
TOTAL	135	MINUS	20	115	x \$18 =	\$2,070.00
INDEPENDENT	9	MINUS	3	6	x \$88 =	\$528.00
		<input checked="" type="checkbox"/> MULTIPLE DEPENDENT CLAIMS			+ \$300 =	\$300.00
		TOTAL OF ABOVE CALCULATIONS				\$2,898.00
		<input type="checkbox"/> Reduction by 50% for filing by Small Entity				\$0.00
		<input type="checkbox"/> Recordation of Assignment			+ \$40 =	\$0.00
		TOTAL				\$2,898.00

- ☐ A check in the amount of \$0.00 is attached.
- ☒ Credit card payment form is attached to cover the fees in the amount of \$2,898.00
- ☒ Please charge any additional Fees for the papers being filed herewith and for which no check or credit card payment is enclosed herewith, or credit any overpayment to deposit Account No. 15-0030. A duplicate copy of this sheet is enclosed.
- ☒ If these papers are not considered timely filed by the Patent and Trademark Office, then a petition is hereby made under 37 C.F.R. §1.136, and any additional fees required under 37 C.F.R. §1.136 for any necessary extension of time may be charged to Deposit Account No. 15-0030. A duplicate copy of this sheet is enclosed.

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.

Marvin J. Spivak  
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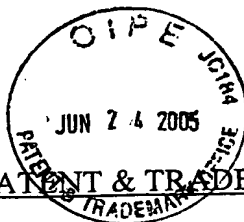
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DOCKET NO: 259687US2PCT



IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF :

AKIRA UMEDA :

ATTN: APPLICATION DIVISION

SERIAL NO: 10/509,630 :

FILED: SEPTEMBER 29, 2004 :

FOR: FREQUENCY CHARACTERISTICS :  
MEASURING METHOD AND  
DEVICE FOR ACCELERATION  
SENSOR

SECOND PRELIMINARY AMENDMENT

COMMISSIONER FOR PATENTS  
ALEXANDRIA, VIRGINIA 22313

SIR:

Prior to a first examination on the merits, please amend the above-identified application as follows:

**Amendments to the Specification** begin on page 2 of this paper.

**Amendments to the Claims** are reflected in the listing of claims which begins on page 6 of this paper.

**Remarks** begin on page 27 of this paper.

## IN THE SPECIFICATION

Please replace the paragraph at page 23, line 25, with the following rewritten paragraph:

In the above, an elastic wave pulse is generated and propagates in the rod by a shock imparted by impacting a projectile on the end surface of the rod that is adequately long compared with its diameter. At the time the elastic wave pulse reaches the end surface and reflects, the end surface of the rod moves at the following acceleration that is twice the product of the propagation velocity (C) of the longitudinal elastic wave and the strain rate ~~{Formula-1}~~  $\dot{\epsilon}(t)$  of the incident elastic wave pulse.

Please replace the line at page 24, line 3, as follows:

~~{Formula-2}~~  $a(t) = 2C\dot{\epsilon}(t)$

Please replace the line at page 24, line 10, as follows:

~~{Formula-3}~~  $a(t) = 2C \sum_{n=1}^N \dot{\epsilon}_n(t)$

Please replace the line at page 25, line 1, as follows:

~~{Formula-4}~~  $\epsilon(z,t) = F(z,t)$

Please replace the line at page 25, line 7, as follows:

~~{Formula-5}~~  $F(z,t) = \epsilon_r(t,z) - \epsilon_r(t - \frac{2l_p}{C_p}, z)$

Please replace the line at page 25, line 16, as follows:

$$\text{[Formula-6]} \quad \varepsilon_i(t, z) = \frac{V_1}{\pi C} \left[ \int_0^\infty \frac{\sin(a_1 \eta + \eta^3 / 3)}{\eta} d\eta + \int_0^\infty \frac{\sin(a_2 \eta + \eta^3 / 3)}{\eta} d\eta \right]$$

Please replace the line at page 25, line 19, as follows:

$$\text{[Formula-7]} \quad a_1 = \frac{Z - C_a t}{\left[ \frac{3}{16} v^2 D_a^2 C t \right]^{1/3}}$$

Please replace the line at page 25, line 21, as follows:

$$\text{[Formula-8]} \quad a_2 = \frac{-Z - C_a t}{\left[ \frac{3}{16} v^2 D_a^2 C t \right]^{1/3}}$$

Please replace the line at page 26, line 16, as follows:

$$\text{[Formula-9]} \quad \varepsilon_n^e(t) = L^{-1} \left[ L[\varepsilon_{L_n}(t)] \frac{L \left[ F(L_1, t - \frac{(L_n - L_1)}{C}) \right]}{L[F(L_n, t)]} \right]$$

Please replace the paragraph at page 26, line 20, with the following new paragraph:

Here, ~~[Formula-10]~~  $L$  and  $L^{-1}$  are a Laplace operator and an inverse Laplace operator.

Therefore, elastic wave pulse strain  $\varepsilon_e(L_1, t)$  at the representative location can be expressed by the following equation.

Please replace the line at page 26, line 24, as follows:

$$\text{[Formula-11]} \quad \varepsilon_r(L_1, t) = \frac{1}{N} \left[ \varepsilon_{L1}(L_1, t) + \sum_{n=2}^N \varepsilon_n^e(t) \right]$$

Please replace the line at page 27, line 13, as follows:

$$\text{[Formula-12]} \quad a(t) = 2C\dot{\varepsilon}_r(L_1, t - \frac{L-L_1}{C})$$

Please replace the line at page 25, line 21, as follows:

$$\text{[Formula-13]} \quad \frac{L[a_{out}(t)]}{2Cj\omega L \left[ \varepsilon_r(L_1, t - \frac{L-L_1}{C}) \right]}$$

Please replace the paragraph at page 27, line 25, with the following new paragraph:

Also, based on elastic wave theory, when strain gauge output is error-corrected, with respect to the strain gauge output signal at the representative location obtained by the above Equation (9), Equation (3) is applied to obtain the strain  $\text{[Formula-14]} \quad \varepsilon_{rIT}(t)$  of the elastic wave pulse incident on the end surface where the acceleration sensor is attached. For this, the following equation is used.

Please replace the line at page 28, line 5, as follows:

$$\text{[Formula-15]} \quad \frac{L[\varepsilon_{rIT}(t)]}{L[\varepsilon_r(t)]} = \frac{L[F(L, t)]}{L[F(L_1, t)]}$$

Please replace the line at page 28, line 13, as follows:

$$\text{[Formula 16]} \quad \frac{L[a_{out}(t)]}{2Cj\omega L[\varepsilon_{rIT}(t)]}$$

Please replace the line at page 25, line 21, as follows:

$$\text{[Formula 17]} \quad \frac{L[a_{out}(t)]}{L\{\frac{dv_{il}(t)}{dt}\}} = \frac{L[a_{out}(t)]}{j\omega L[v_{il}(t)]}$$

Please replace the line at page 29, line 5, as follows:

$$\text{[Formula 18]} \quad v_L(t) = 2C\varepsilon_{il}(t)$$

Please replace the line at page 29, line 15, as follows:

$$\text{[Formula 19]} \quad G_{CL}(j\omega) = \frac{L\left[\varepsilon_r(L_1, t - \frac{L - L_1}{C})\right]}{L[\varepsilon_{il}(t)]}$$

IN THE CLAIMS

Please amend the claims as follows:

Claims 1-34 (Canceled).

Claim 35 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and

obtaining a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the strain gauge.

Claim 36 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using an optical measuring instrument to measure a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod, and

obtaining a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument.

Claim 37 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof inclined at a prescribed angle to a direction of gravity acceleration,

impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and

obtaining from a signal from the direct current acceleration sensor and a signal from the strain gauge a frequency response of the direct current acceleration sensor, with the direct current acceleration sensor affected by the gravity acceleration, and comparing data of said

frequency response of the direct current acceleration sensor with data of the frequency response obtained by the method of claim 35, thereby obtaining characteristics with respect to the gravity acceleration in said frequency response of the direct current acceleration sensor.

Claim 38 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof inclined at a prescribed angle to a direction of gravity acceleration,

impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using an optical measuring instrument to measure a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod, and

obtaining from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument a frequency response of the direct current acceleration sensor in a state in which the gravity acceleration affects the direct current acceleration sensor and comparing data of said frequency response of the direct current acceleration sensor with data of the frequency response obtained by the method of claim 36, thereby obtaining characteristics with respect to the gravity acceleration in said frequency response of the direct current acceleration sensor.

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Claim 39 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

releasing support of the metal rod to produce a free fall state,

during a period of releasing the support of the metal rod, impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod,

supporting the metal rod immediately after measuring the strain, and

obtaining a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the strain gauge.

Claim 40 (New): A method for measuring frequency characteristics of a direct current acceleration sensor, comprising:

supporting a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

releasing support of the metal rod to produce a free fall state,

during a period of releasing the support of the metal rod, impacting one of end surfaces of the metal rod with a projectile to generate and propagate an elastic wave pulse in the metal rod,

using a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

using an optical measuring instrument to measure a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod,

supporting the metal rod immediately after measuring the velocity of motion, and obtaining a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument.

Claim 41 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 35, 37, and 39, in which the one end surface of the metal rod is impacted with the projectile to generate the elastic wave pulse in the metal rod, further comprising:

taking as an input signal to the direct current acceleration sensor provided on the other end surface of the metal rod dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface,

using the direct current acceleration sensor to detect, and the strain gauge provided on the side surface of the metal rod to measure, the input signal having time as a function,

carrying out signal processing with respect to an output signal from the direct current acceleration sensor and an output signal from the strain gauge, and

using data that has been signal processed as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current

acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 42 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to any of claims 35, 37, and 39, in which the one end surface of the metal rod is impacted with the projectile to generate the elastic wave pulse in the metal rod, further comprising:

taking as an input signal to the direct current acceleration sensor provided on the other end surface of the metal rod dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface,

using the direct current acceleration sensor to detect, and the strain gauge provided on the side surface of the metal rod to measure, the input signal having time as a function,

carrying out signal processing of an output signal from the direct current acceleration sensor and an output signal from the strain gauge,

carrying out error correction of the output signal from the strain gauge based on elastic wave theory, and

using data that has been signal processed and error corrected as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 43 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 36, 38, and 40, in which the one end surface of the metal rod is impacted with the projectile to generate the elastic wave pulse in the metal rod, further comprising:

taking as an input signal to the direct current acceleration sensor provided on the other end surface of the metal rod dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface,

using the direct current acceleration sensor to detect, and the optical measuring instrument to directly measure, the input signal having time as a function,

carrying out signal processing with respect to an output signal from the direct current acceleration sensor and the output signal from the optical measuring instrument, and

using data that has been signal processed as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 44 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 35, 37, and 39, in which the one end surface of the metal rod is impacted with the projectile to generate the elastic wave pulse in the metal rod, further comprising:

taking as an input signal to the direct current acceleration sensor provided on the other end surface of the metal rod dynamic displacement, velocity or acceleration in a direction

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normal the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface,

using the direct current acceleration sensor to detect, and the strain gauge provided on the side surface of the metal rod to measure, the input signal having time as a function,

carrying out signal processing of an output signal from the direct current acceleration sensor and an output signal from the strain gauge,

carrying out error correction of the output signal from the strain gauge based on elastic wave theory,

using a correction function relating to dynamic characteristics of the strain gauge to correct results of measurements by the gauge, and

using data that has been signal processed, error corrected and measurement-result-corrected as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 45 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 41, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

Claim 46 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 42, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

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Claim 47 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 44, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

Claim 48 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 41, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided on the circumference at equal distances from the one end surface of the metal rod.

Claim 49 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 42, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided on the circumference at equal distances from the one end surface of the metal rod.

Claim 50 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 44, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided on the circumference at equal distances from the one end surface of the metal rod.

Claim 51 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 41, wherein the projectile that impacts the one end surface of the metal rod is composed of a plurality of round, concentric projectiles launched from a launch apparatus that includes multiple round, concentric launch tubes, in

which the launch apparatus can precisely and independently control launch timing of each projectile launched.

Claim 52 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 42, wherein the projectile that impacts the one end surface of the metal rod is composed of a plurality of round, concentric projectiles launched from a launch apparatus that includes multiple round, concentric launch tubes, in which the launch apparatus can precisely and independently control launch timing of each projectile launched.

Claim 53 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 43, wherein the projectile that impacts the one end surface of the metal rod is composed of a plurality of round, concentric projectiles launched from a launch apparatus that includes multiple round, concentric launch tubes, in which the launch apparatus can precisely and independently control launch timing of each projectile launched.

Claim 54 (New): A method for measuring frequency characteristics of a direct current acceleration sensor according to claim 44, wherein the projectile that impacts the one end surface of the metal rod is composed of a plurality of round, concentric projectiles launched from a launch apparatus that includes multiple round, concentric launch tubes, in which the launch apparatus can precisely and independently control launch timing of each projectile launched.

Claim 55 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising:

a metal rod support apparatus that supports a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

a launch apparatus for impacting one of end surfaces of a metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and

a processor for calculating a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the strain gauge.

Claim 56 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising:

a metal rod support apparatus that supports a metal rod with a center axis thereof aligned with a direction of gravity acceleration,

a launch apparatus for impacting one of end surfaces of a metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

an optical measuring instrument for measuring a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod, and

a processor for calculating a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument.

Claim 57 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising:

a metal rod support apparatus that supports a metal rod with a center axis thereof inclined at a prescribed angle to a direction of gravity acceleration,

a launch apparatus for impacting one of end surfaces of the metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and

a processor that obtains a frequency response of the direct current acceleration sensor, with the direct current acceleration sensor affected by the gravity acceleration, from a signal from the direct current acceleration sensor and a signal from the strain gauge and compares data of said frequency response of the direct current acceleration sensor with data of the frequency response calculated by the processor in claim 55 to calculate characteristics with respect to gravity acceleration in said frequency response of the direct current acceleration sensor.

Claim 58 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising:

a metal rod support apparatus that supports a metal rod with a center axis thereof inclined at a prescribed angle to a direction of gravity acceleration,

a launch apparatus for impacting one of end surfaces of the metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

an optical measuring instrument for measuring a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod, and

a processor that obtains a frequency response of the direct current acceleration sensor, with the direct current acceleration sensor affected by the gravity acceleration, from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument and compares data of said frequency response data with data of the frequency response of the direct current acceleration sensor calculated by the processor described in claim 56 to calculate characteristics with respect to gravity acceleration in said frequency response.

Claim 59 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising

a metal rod support apparatus that supports a metal rod with a center axis thereof aligned with a direction of gravity acceleration, releases support of the metal rod to produce a free fall state and re-supports it after a prescribed time,

a launch apparatus that during a period of releasing the support of the metal rod impacts one of end surfaces of the metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod,

a strain gauge provided on a side surface of the metal rod to measure metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and

a processor for calculating a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the strain gauge.

Claim 60 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor, comprising:

a metal rod support apparatus that supports a metal rod with a center axis thereof aligned with a direction of gravity acceleration, releases support of the metal rod to produce a free fall state and re-supports it after a prescribed time,

a launch apparatus that during a period of releasing the support of the metal rod impacts one of end surfaces of the metal rod with a projectile to generate an elastic wave pulse in the metal rod,

a direct current acceleration sensor provided on the other of the end surfaces of the metal rod to detect an acceleration arising when the elastic wave pulse reflects at the other end surface of the metal rod during the period of releasing the support of the metal rod,

an optical measuring instrument for measuring a velocity of motion of the other end surface of the metal rod arising when the elastic wave pulse reflects at the other end surface of the metal rod, and

a processor for calculating a frequency response of the direct current acceleration sensor from a signal from the direct current acceleration sensor and a signal from the optical measuring instrument.

Claim 61 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55, 57, and 59, including the launch apparatus for impacting the one end surface of the metal rod with the projectile to generate the elastic wave pulse in the metal rod, wherein the direct current acceleration sensor detects an input signal having time as a function that is dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface of the metal rod, said input signal constituting an input signal to the direct current acceleration sensor provided on the other end surface, the strain gauge provided on the side surface of the metal rod measures metal rod strain caused by the impact of the projectile against the other end surface of the metal rod, and the processor carries out signal processing with respect to an output signal from the direct current acceleration sensor and an output signal from the strain gauge and uses data that has been signal processed as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 62 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any of claims 55, 57, and 59, including the launch apparatus for impacting the one end surface of the metal rod with the projectile to generate the elastic wave pulse in the metal rod, wherein the direct current acceleration sensor detects an input signal as a function of time standing for dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface of the metal rod, said input signal constituting an input signal to the direct current acceleration sensor provided on the other end surface, the strain gauge provided on the side surface of the metal rod measures metal rod strain caused by the collision of a projectile, and the processor carries out signal processing with respect to an output signal from the direct current acceleration sensor and an output signal from the strain gauge, carries out error correction of the output signal from the strain gauge based on elastic wave theory, and uses data that has been signal processed and error corrected as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 63 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 56, 58, and 59, including the launch apparatus for impacting the one end surface of the metal rod with the projectile to generate an elastic wave pulse in the metal rod, wherein the direct current acceleration sensor detects an input signal as a function of time standing for dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface of the metal

rod, said input signal constituting an input signal to the direct current acceleration sensor provided on the other end surface, the optical measuring instrument directly detects the input signal, and the processor carries out signal processing with respect to an output signal from the direct current acceleration sensor and an output signal from the optical measuring instrument and uses data that has been signal processed as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 64 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55, 57, and 59, including the launch apparatus for impacting the one end surface of the metal rod with the projectile to generate the elastic wave pulse in the metal rod, wherein the direct current acceleration sensor detects an input signal as a function of time standing for dynamic displacement, velocity or acceleration in a direction normal to the other end surface produced when the elastic wave pulse generated by the impact of the projectile reflects at the other end surface of the metal rod, said input signal constituting an input signal to the direct current acceleration sensor provided on the other end surface, the strain gauge provided on the side surface of the metal rod measures metal rod strain caused by the collision of a projectile, and the processor carries out signal processing with respect to an output signal from the direct current acceleration sensor and an output signal from the strain gauge, carries out error correction of the output signal from the strain gauge based on elastic wave theory, uses a correction function relating to motion characteristics of the strain gauge obtained using an optical measuring instrument to correct results of measurement by the strain gauge and uses data that

has been signal processed, error corrected and measurement-result corrected as a basis for measuring gain-frequency characteristics, phase-frequency characteristics and peak sensitivity of the direct current acceleration sensor in respect of each of dynamic displacement detection function, velocity detection function and acceleration detection function of the direct current acceleration sensor.

Claim 65 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 61, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

Claim 66 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 62, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

Claim 67 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 64, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at different distances from the one end surface of the metal rod.

Claim 68 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 61, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at equal distances from the one end surface of the metal rod.

Claim 69 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 62, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at equal distances from the one end surface of the metal rod.

Claim 70 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 64, wherein the strain gauge provided on the side surface of the metal rod is composed of a plurality of strain gauges provided at equal distances from the one end surface of the metal rod.

Claim 71 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55 to 60, wherein the projectile that impacts the one end surface of the metal rod is composed of a plurality of round, concentric projectiles launched from the launch apparatus that includes multiple round, concentric launch tubes, and the launch apparatus can precisely and independently control launch timing of each projectile launched.

Claim 72 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55 to 60, wherein the launch tube in the launch apparatus that launches the projectile has a surface treated to reduce friction with the projectile.

Claim 73 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55 to 60, wherein the apparatus for

measuring the frequency characteristics of the direct current acceleration sensor measures frequency characteristics from shock acceleration in a low peak, narrow frequency band domain of the direct current acceleration sensor.

Claim 74 (New) An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any of claims 56, 58, and 60, wherein the optical measuring instrument comprises a laser interferometer.

Claim 75 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to claim 71, wherein the one end surface of the metal rod contacts a metal ball and the launch apparatus that launches a plurality of projectiles in a concentric circle from the multiple launch tubes precisely controls launch timing with respect to said metal ball to generate an elastic wave pulse in the metal rod.

Claim 76 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55 to 60 wherein the projectile has a structure that is a lamination of different materials to control a frequency band of the elastic wave pulse generated in the metal rod by the impact of the projectile.

Claim 77 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any of claims 55 to 60, wherein in accordance with a theoretical propagation of the elastic wave in the metal rod, when obtaining transient signal distortion of an elastic wave pulse from the strain gauge output signal incident on the one end surface, at least a primary term of a series-expanded Skalak's analytic solution is used.

Claim 78 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any of claims 55 to 60, wherein in accordance with a theoretical propagation of the elastic wave in the metal rod, when obtaining transient signal distortion of an elastic wave pulse from the strain gauge output signal incident on the one end surface, up to a high-order term of a series-expanded Skalak's analytic solution is used.

Claim 79 (New): An apparatus for measuring frequency characteristics of a direct current acceleration sensor according to any one of claims 55 to 60, wherein the direct current acceleration sensor has a peak sensitivity determined in accordance with an input acceleration waveform and frequency band produced by a plurality of projectiles launched from the launch apparatus with precisely controlled launch timing.

REMARKS

Favorable consideration of this application, as presently amended, is respectfully requested.

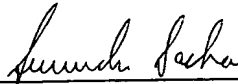
By the present preliminary amendment the specification is amended to make minor changes.

Further, claim 1 is canceled without prejudice and new claims 35-79 are presented for examination. New claims 35-79 are deemed to be self-evident from the original disclosure, including the original claims, and thus are not deemed to raise any issues of new matter. New claims 35-79 are written to not recite any improper multiple dependencies.

The present application is believed to be in condition for a full and thorough examination on the merits. An early and favorable consideration of the present application is hereby respectfully requested.

Respectfully submitted,

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